CHAPTER 5
Water Level Requirements of Lake Istokpoga Resources (Results)

ANALYSIS OF HISTORIC AND CURRENT HYDROLOGICAL CONDITIONS

Historical Water Levels on Lake Istokpoga

Prior to 1962, high water events (above 40 feet NGVD) regularly occurred on Lake Istokpoga. From 1936 to 1962, high water events occurred 14 times (**Table 12** and **Figure 16**) with a return frequency of approximately once every two years. These periods of high water levels can play an important environmental role by: 1) depositing organic matter within the floodplain to be oxidized and decomposed as flood waters recede; 2) inundating swamp lands, reducing understory growth; and 3) transporting viable seeds throughout the area, supporting wetland reproduction and species diversity. Since construction and operation of water control structures, water levels briefly reached 40 feet NGVD only once between 1962 and 2002.

Table 12. Lake Istokpoga Water Level Statistics from the Historic Period of Record; all Values are Feet NGVD.

	1936–1962	1962–1989	1989–2000
Mean	38.6	38.5	38.8
Standard Deviation	1.3	0.8	0.56
Count (*n*)	9649	9862	4298
Median	38.5	38.6	39.0
Mode	38.4	39.4	39.4
Minimum	35.4	36.2	37.2
Maximum	42.9	40.1	39.9
Range	7.5	3.9	2.7

After 1962 and especially after 1989, the duration, magnitude and frequency of low water events were reduced from the historic (pre-1962) condition. In the period from 1936–1962, there were six natural low water events (at or below 36.5 feet NGVD) with an average duration of seven weeks and a return frequency of once every 3.4 years (**Table 13**). In the period from 1962–1985, two low water events occurred, one associated with a drawdown of the lake for construction of the S-68 in 1962. After 1985, water

levels dropped below 36.5 feet NGVD only once during a controlled vegetation enhancement project in 2001.

Table 13. Frequency and Duration of Low Water Events on Lake Istokpoga for the Period of Record 1939–2002.

Year	Duration[1] (Weeks)	Years Since Last Event
1939	less than 1	N/A
1945	5	6
1949	3	4
1950	6	1
1955	7	5
1956	20	1
1962 Drawdown	18	N/A[2]
1971	6	9
2001 Drawdown	19	N/A[2]
1939–2000 Mean	8	5
1939–2000 Median	6	5
1939–1963 Mean	9	4
1939–1963 Median	6	5

1. Event defined as a period of continuous lake levels of 36.5 feet NGVD or less, with less than seven continuous days at or above 36.5 feet
2. N/A=not applicable; drawdown was not a natural event

Extremely low water levels can play an important environmental function by: 1) drying, compaction and oxidation of organic matter in the lake's littoral zone and lake bed; 2) permitting germination and establishment of swamp and marsh vegetation; and 3) temporarily concentrating aquatic prey into smaller areas to support wading bird and raptor foraging and rearing of chicks. Prior to human suppression of natural fires, flatwood burns would ignite dewatered lake bottom and consume exposed organic matter (FWC 2000). These periodic drawdown episodes were a vital mechanism for maintaining a sandy lake bottom, reducing in-lake storage of nutrients and controlling growth of littoral zone vegetation communities. Extreme lake dry down played an important role in maintaining the shallow character of the lake and, if no sediment removal projects are implemented, suppression of low water levels could lead to eventual succession of the lake to a marsh (FWC 2000).

Current Regulation Schedule

Water levels in Lake Istokpoga are controlled by operation of water control structures (S-68 and G-85) and guided by a regulation schedule adopted by the U.S. Army Corps of Engineers and the SFWMD (**Figure 11**). Some benefits of the Regulation Schedule are: 1) the reduced potential for flooding lakeside homes and businesses; 2) a reduction in the number and severity of low water level events, which aids navigational

access important to the local economy; and 3) sufficient dry season water availability for recreation, boating and fishing interests, and water supply to downstream users. However, without natural lake level fluctuations germination of aquatic plant seeds is reduced, buildup of organic sediments occurs and the formation and expansion of floating vegetation mats are promoted. The Regulation Schedule will be reevaluated by the LOW CERP Project. That project's purpose is to examine the Lake Istokpoga Basin with a view toward creating a balance among the environment, water supply and flood control needs in the drainage basin. The LOW CERP Project will address the need for flood protection for the perimeter and upstream tributaries, and for downstream areas west and east of the C-41A Canal, as well as water supply needs of both agricultural users and the Seminole Tribe of Florida.

Because MFLs are concerned with low water levels that cause *significant harm* to the resource, addressing environmental impacts from water level stabilization is beyond this project's scope. In addition, it is unlikely that *significant harm* would occur under the current regulation schedule since low water events no longer occur to the degree that existed before water level stabilization. However, because the regulation schedule will be reviewed by the LOW CERP Project and periodic drawdowns are being proposed to benefit the natural communities within the lake, determining the point of *significant harm* to the current resource caused by low water levels will be useful for providing minimum lake level criteria.

IMPACTS OF LOW WATER LEVELS TO NAVIGATION AND RECREATION

Low Water Level Impact to Navigation and Recreation

In 1974, the SFWMD's Governing Board adopted a Regional Water Shortage Plan for the Lake Istokpoga-Indian Prairie Area (Part I, Chapter 40E-22, F.A.C). This Plan established a minimum permissible schedule (water level) for Lake Istokpoga of 37.0 feet NGVD, based on "…staff knowledge of recreational navigation access problems in the lake and resident's views of desirable lake stages as expressed at public meetings and in correspondence to the District..." (SFWMD 1991). Public and stakeholder comments at public meetings indicated that some problems with lake access began to appear when water levels fell below 38 feet NGVD. A review of Lake Istokpoga's hydrograph (**Figure 16**) indicates that naturally-occurring low water conditions (i.e., at or below 36.5 feet NGVD) occurred infrequently and seldom lasted for more than two months, except during periods of drought (**Table 13**). The longest low water event in the period of record occurred during a two year period (1955–1956) when water levels were below 36.5 feet NGVD for a total of 27 weeks (**Table 13**). Prolonged low water levels can impact not only navigation, but recreation-based businesses along Lake Istokpoga. Under the current regulation schedule (**Figure 11**) these effects are usually temporary and occur only when a controlled drawdown is conducted to enhance shoreline vegetation communities.

The LOW CERP Project is currently re-examining the Lake Istokpoga Regulation Schedule. To develop a navigation access performance measure, a group of local experts were asked to provide input to the navigation and recreational access impairment associated with different water levels (Dr. Nellie Morales, personal communication). The findings from this effort are shown in **Table 14**.

Table 14. Proposed Lake Istokpoga Navigation Performance Measure (Source: USACE and SFWMD 2005)

Lake Stage (ft-NGVD)	Private Access Status	Public Access Status
≥ 38.0	Minimum (start) impact.	No impact.
37.5 – 37.99	Impaired access.	Minimum (start) impact. At these stages, difficulties in getting boats into water and navigate the lake are observed. Hydrilla is also a factor. Boaters would have easier access at any of these stages if no hydrilla were present within the lake. Hydrilla does not impair access; it impairs navigation. This is true at any water level; however, the lower the lake level, the greater the impact hydrilla has on navigation and the more likely it will affect navigation (shallower water means less water for hydrilla to mat-out).
37.0 – 37.49	Severely impaired.	Impaired access. Problems at public boat ramps for large boats.
36.5 – 36.99	No private access.	Severely impaired access. All public boat ramps will be impaired for pontoon boats and all non-shallow-draft boats. There is approximately 50% more access impairment than at 37.0 ft. No access from RV parks. Fish camps still have limited access. Navigation is very limited (limit to where you can fish).
36.0 – 36.49		Limited access through fish camps. Public can access the lake through 2 of the fish camps. Pay a boat-ramp fee to access the lake. Access at public ramps is limited to non-motorized/electric-motor boats (canoes, etc.), small-engine jon-boats that can be manually launched (carried/pushed), and airboats.
<36.0		All public access is impaired.

HYDROLOGICAL REQUIREMENTS OF NATURAL SYSTEMS

Requirements of Aquatic and Wetland Communities

Major Wetland Communities in Lake Istokpoga

Hydrological conditions in wetland communities fringing Lake Istokpoga are directly controlled by lake levels. These wetlands provide important ecological functions to the lake and should be protected. Some benefits afforded by these wetlands include:

- Stabilization of lakeshore sediments and soils; dampening effects of wind and wave energy.
- Water quality improvements by assimilating and processing of pollutants, and reducing sediment resuspension by stabilizing shorelines and lake bottoms.
- Wildlife habitat.
- Aesthetic values.
- Critical fish habitat that supports the locally important sport fishing economy.

The general types of wetlands found along Lake Istokpoga include marsh (typically located in the littoral zone), swamp, shrub wetlands and wet prairie (**Figure 18**). Littoral zone marsh is the most abundant wetland type (**Table 5**), encompassing more than 3,400 acres (1,400 ha). Littoral zone marsh includes both emergent and cattail-dominated wetlands. Forested wetlands (swamps) are also a dominant wetland type along Lake Istokpoga, although they cover about half of the area of littoral marsh. This wetland category includes swamps dominated by bald cypress, mixed swamp hardwoods or a mixture of both. Other wetland types of minor extent include shrub wetlands, usually containing wax myrtle or willow, and wet prairie. The typical hydroperiod for some of these wetland types are shown in **Table 15**.

Water Level Requirements of Lake Istokpoga Wetlands

Using recent bathymetry data, surface elevation maps for the largest wetland areas around Lake Istokpoga were created (**Figures 27, 28 and 29**). Examination of these maps indicate that littoral zone emergent vegetation (marsh) communities generally reside between 36.5 and 39.5 feet NGVD and bald cypress/mixed hardwood swamp are generally found at elevations of 39.5 feet NGVD and higher. The ecotone between aquatic and deep marsh communities lies at approximately 36.5 feet NGVD and between marsh and swamp at approximately 39.5 feet NGVD. There can be some variation from these general elevations as the transition can be gradual and it is sometimes difficult to discern the place where one community definitively ends and another begins.

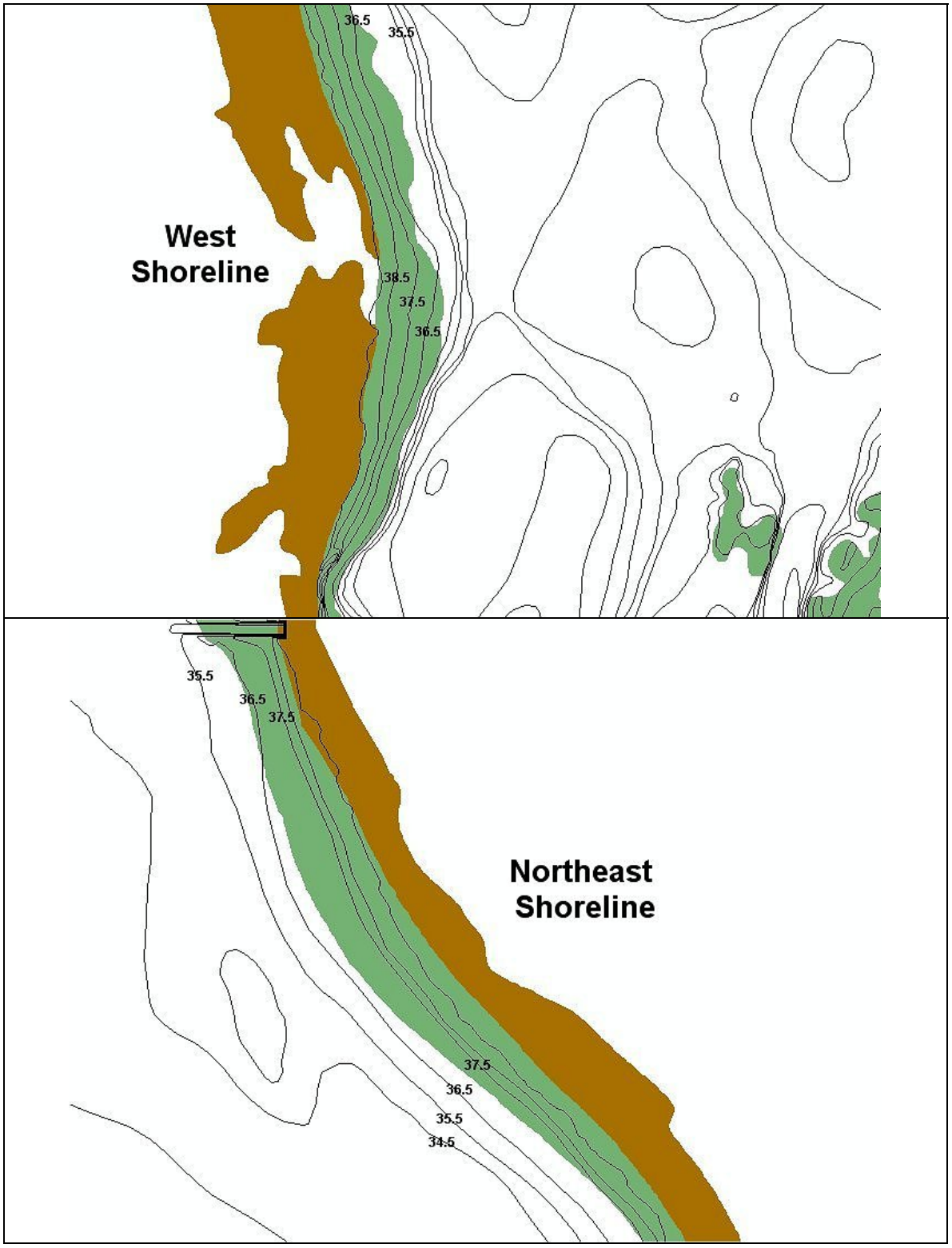

Figure 27. Elevations within Lake Istokpoga Littoral Wetlands along the West and Northeast Shorelines; Green Areas Indicate Marsh, Brown Areas Indicate Swamp, Orange Areas Indicate Shrub and Purple Areas Indicate Wet Prairie Habitats.

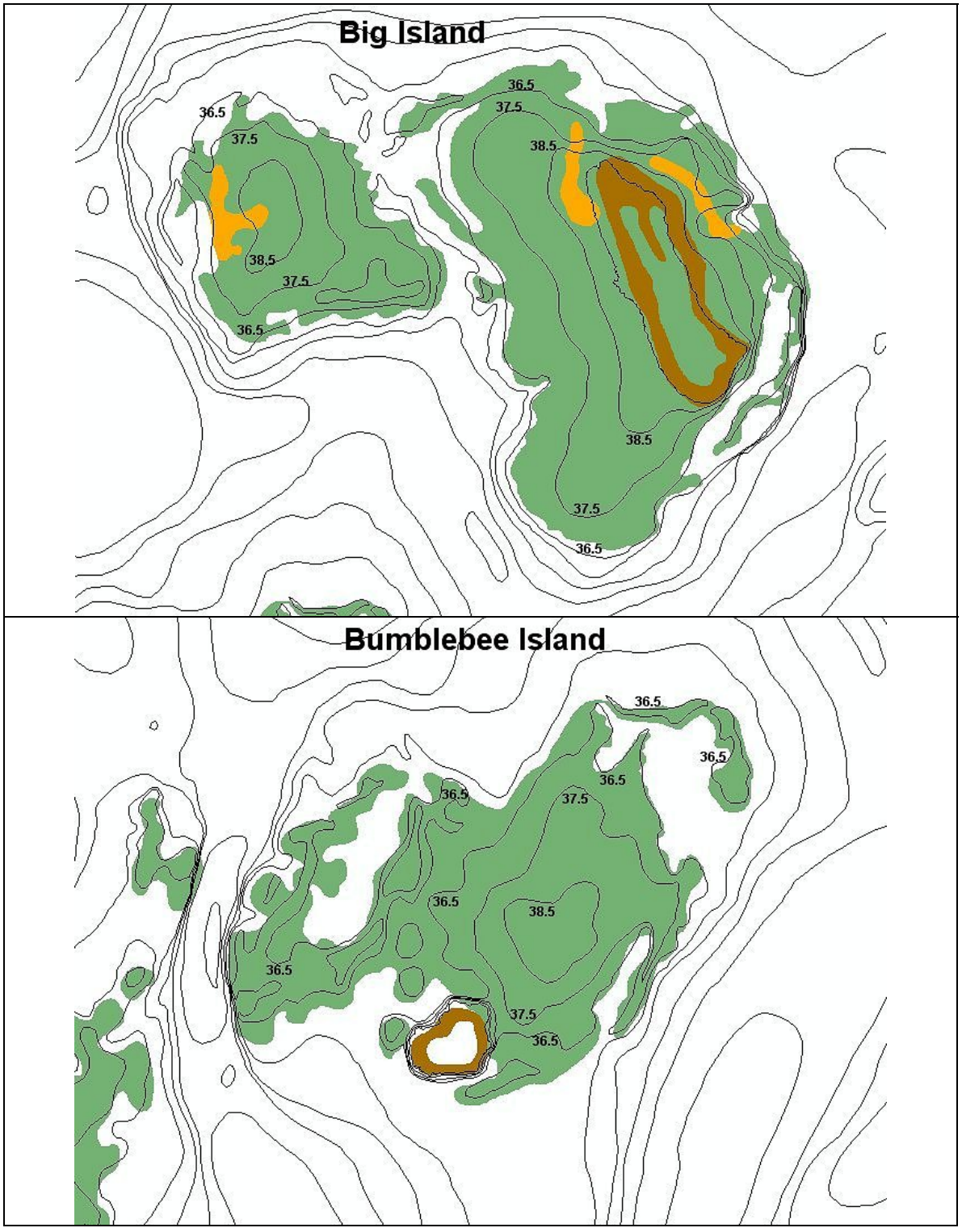

Figure 28. Elevations within Lake Istokpoga Wetlands on Big and Bumblebee Islands; Green Areas Indicate Marsh, Brown Areas Indicate Swamp, Orange Areas Indicate Shrub and Purple Areas Indicate Wet Prairie Habitats.

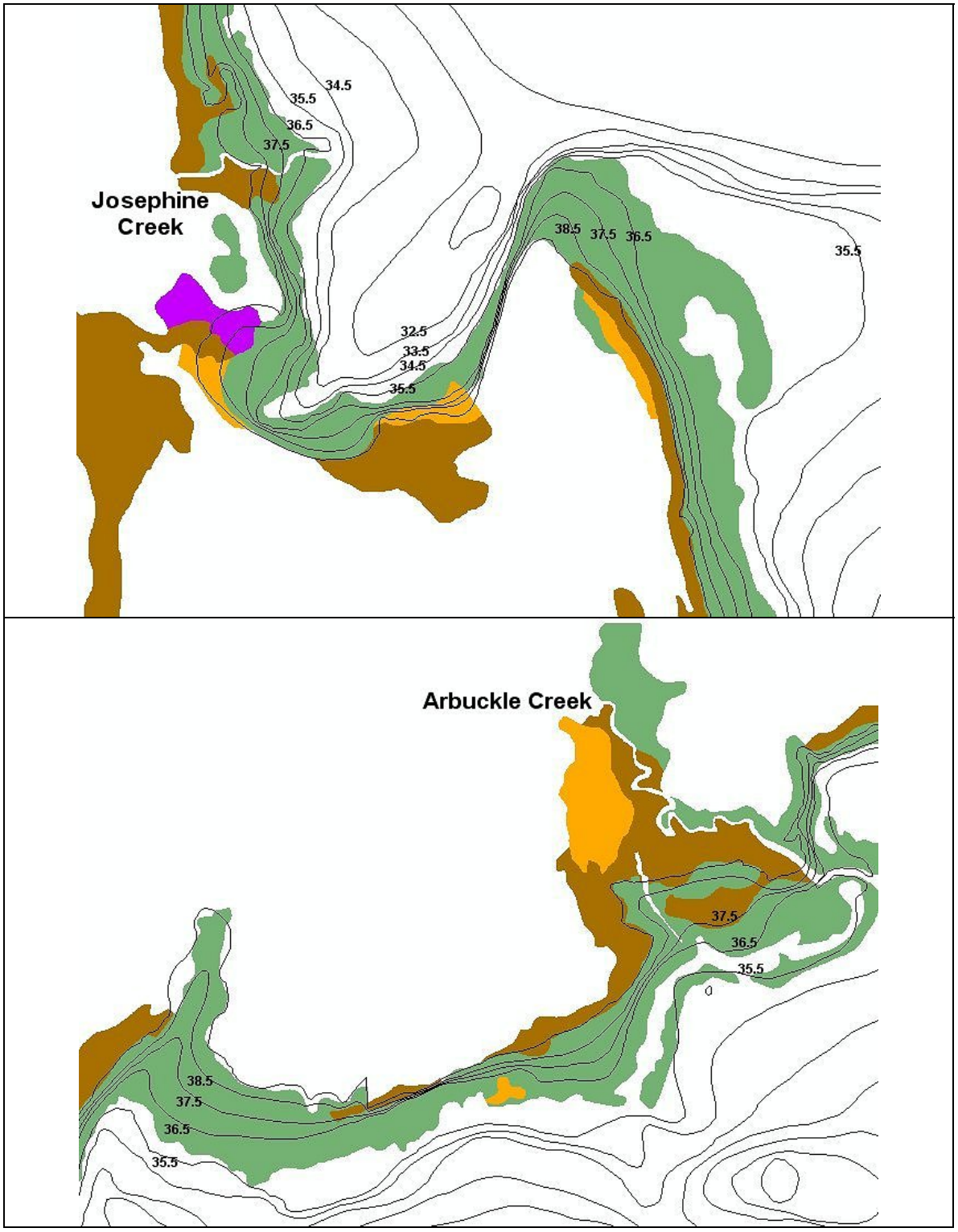

Figure 29. Elevations within Lake Istokpoga Littoral Wetlands at Josephine and Arbuckle Creeks; Green Areas Indicate Marsh, Brown Areas Indicate Swamp, Orange Areas Indicate Shrub and Purple Areas Indicate Wet Prairie Habitats.

The MFL is concerned with protecting the existing resources of the lake and the current extent of natural communities, although the elevation and extent of natural communities may have changed since stabilization of lake levels in the early 1960s. Since high and low water events occurred more frequently on Lake Istokpoga before the 1960s, marsh and aquatic habitats may have occupied different elevations than they do today. Insufficient historical data exists to determine the precise historical extent of these communities. The bald cypress and mixed swamp hardwood communities contain trees of significant age and most likely persist in the same elevations they historically occupied.

The average hydroperiods of major wetland types were obtained from a review of ecological publications (**Table 15**) and compared with long-term lake water level data. In addition, average littoral wetland hydroperiods from the historic period (1936–1963) and the managed system (1963–2001) were compared (**Figure 30**). These results indicate that implementation of lake level management has caused hydroperiods of littoral zone marsh habitats (at current elevations) to increase and swamp habitats to decrease. Only infrequently has inundation of the entire fringing swamp occurred since lake level regulation for flood control, as the upper level of the schedule is close to the ground surface elevation.

Annual average hydroperiods of bald cypress/mixed hardwood swamp are typically longer than three months and during drought conditions, water levels can fall to 3 feet below the soil surface (**Table 15**). If the average hydroperiod is reduced below the minimum range typical for cypress swamp (i.e., three months or less), over long periods of time the community may become dominated by species more characteristic of drier communities. Prolonged or frequently recurring extreme low water periods would cause excessive drying of the soil, damage to swamp vegetation and increase fire frequency.

At 36.5 feet NGVD, the lake level is approximately 3.0 feet below the swamp's soil surface, which is the low water depth extreme (in a drought condition) reported for bald cypress (**Table 15**). Analysis of historic extreme low water events indicates that, on average, the lake fell below 36.5 feet NGVD for seven weeks once every three years (**Table 13**). During the planned 2001 drawdown, lake levels were below 36.5 feet for 19 weeks. No adverse impact to the lake's swamp community was reported during or following the drawdown event (FWC 2002).

The surface elevation of deep marsh habitat (long-hydroperiod marsh) is at approximately 36.5 feet NGVD (**Figures 27, 28 and 29**), corresponding to a point where the aquatic beds become exposed. Annual average hydroperiods typical for deep marsh habitats is between 10–12 months (**Table 15**) and this community is typically exposed only during drought periods. The drought management criterion of 37 feet NGVD in the regulation schedule (**Figure 11**) protects these wetlands from extreme drying events that may be harmful. The effect of the 2001 drawdown event on the lake's littoral marsh community was generally viewed as beneficial (FWC 2002).

Table 15. Average Hydroperiod and Inundation Depths for Select Wetland Types.

Wetland Type (Reference)	Mean Annual Low Water Depth	Hydroperiod (months)
Marsh–Shallow		
CH2M Hill 1996a,b	Subsurface	3–7
ESE 1992	Subsurface	4
Marsh		
Duever 2002	0.5–3.8 ft.*	6–10
Ewel 1990	Subsurface	6–9
CH2M Hill 1996a,b	Subsurface	6–10
Marsh–Deep		
Brown and Starnes 1983	Subsurface	12
ESE 1992	Subsurface	10
CH2M Hill 1996a,b	Subsurface	10–12
Lake Marsh		
ESE 1992 (littoral)	Subsurface	6
ESE 1992 (pelagic)	Subsurface	12
Swamp–Mixed, Shallow		
ESE 1992	Subsurface	3
Swamp–Mixed		
Brown and Starnes 1983	Subsurface	6–8
CH2M Hill 1996a,b	Subsurface	3–6
Duever 2002	0.5–3.0 ft. *	8–10
ESE 1992	Subsurface	5
Ewel 1990	Subsurface	6–9
Swamp–Mixed, Deep		
CH2M Hill 1996a,b	Subsurface	5–9
ESE 1992	Subsurface	6
Swamp–Cypress, Shallow		
CH2M Hill 1996a,b	Subsurface	3–7
Swamp–Cypress		
CH2M Hill 1996a,b	Subsurface	6–9
Duever 2002	1.3–3.8 ft.*	6–8
ESE 1992	Subsurface	7
Swamp–Lake Fringe		
Ewel 1990	Subsurface	6–9

*Minimum range indicates depth expected during a 1-in-10-year drought.

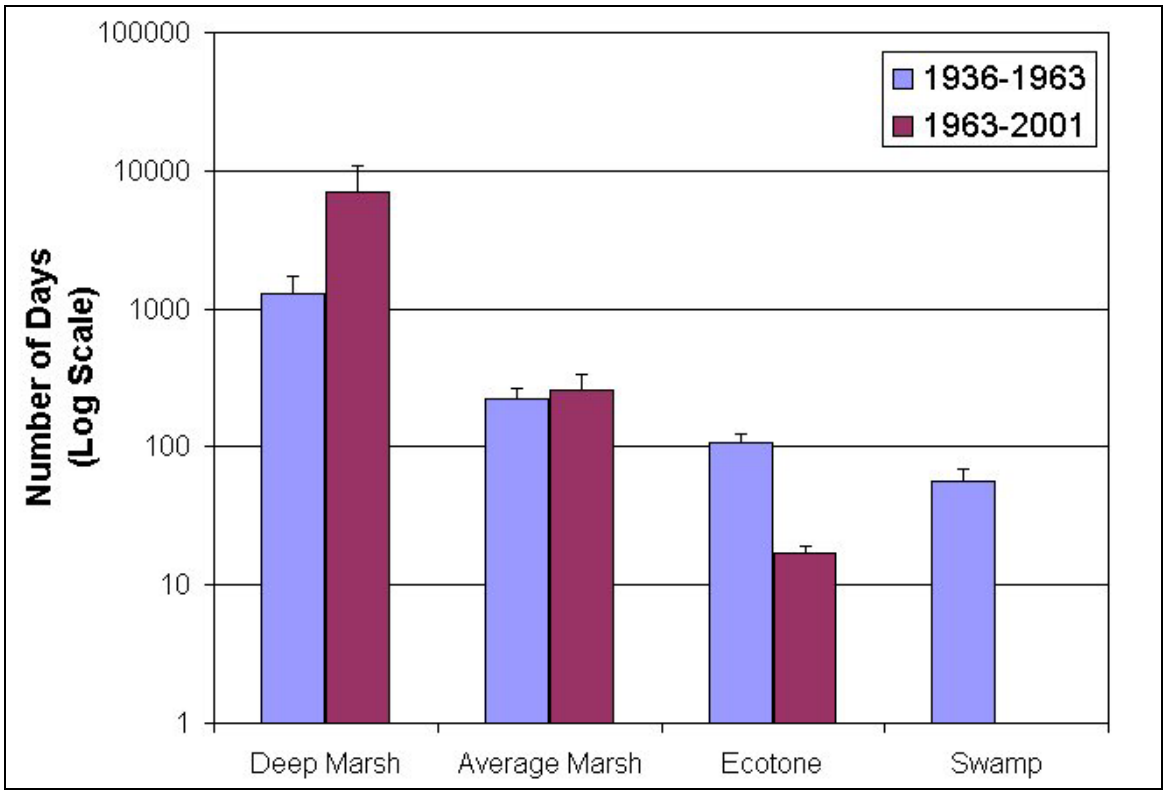

Figure 30. Average Hydroperiod in Wetlands along Lake Istokpoga; Period of Record Excluded the 2001 Controlled Drawdown. Standard Deviation is shown by the Error Bars.

Water Level Requirements of Fish Communities

Measures are being taken to enhance and protect fish communities, including maintenance of critical littoral zone and aquatic habitats, the implementation of slot limits for catches, vegetation management and drawdown of lake levels to remove accumulated sediments. As part of the 2001 drawdown, lake levels were reduced to below 36.5 feet NGVD for 19 weeks to allow enhancement of fish habitats and to control nonnative vegetation. Fishing data suggest the 2001 drawdown of lake levels caused a reduction of some fish populations following treatment, but populations rebounded to pre-drawdown levels by the 2002–2003 sampling event (November–March angler success data, see **Table 10**).

Based on fish sampling data, this drawdown event may have caused short-term impact to the fish community; however, *significant harm* to the resource was not documented. The magnitude and duration of the 2001 drawdown event was comparable to natural low water events that occurred before management of lake levels (see **Figure 16** and **Table 13**). However, long-lasting low water events have not occured in close succession historically and such a scenario should be avoided to prevent multiyear impacts to year classes of fish. Excessively prolonged water levels below 36.5 feet NGVD may be harmful to the fish communities since littoral zone habitats, which are important fish foraging and spawning areas, are dry at this stage. Severe or frequent low

water conditions that cause a change from a marsh to a more upland-like community type could reduce the quality of fish habitats and lead to reduced fish spawning success and foraging. Therefore, protection of the lake's wetland and aquatic communities is a key factor to prevent *significant harm* to fisheries.

The historic magnitude and frequency of low water level events before management of lake levels is unlikely to occur again because of constraints on the system due to water supply, navigational, recreational and economic issues. However, periodic drawdown of water levels below 36.5 feet NGVD of the duration and magnitude of the 2001 event, appear to offer a net environmental benefit by regenerating the littoral zone marsh habitat.

Water Level Requirements of Bird Communities

Utilization of Lake Istokpoga Habitats by Birds

Lake Istokpoga contains three types of habitats that are important for bird species—aquatic, littoral marsh and swamp. **Table 16** presents the bird species in Highlands County associated with Lake Istokpoga habitats. **Figure 18** shows the distribution of these habitat types around Lake Istokpoga. Most bird species require more than one habitat type to successfully feed, nest and rear chicks to adulthood (Ehrlich *et al.* 1988, Bird 1999). For example, ospreys nest in the swamp adjacent to the lake and feed from the lake's aquatic habitat (Stewart 2001). Of the 26 known species of birds associated with Lake Istokpoga habitats, 21 use more than one habitat type (**Appendix E**).

The primary habitat types that are used by birds in the Lake Istokpoga area are:

- Aquatic habitats are open-water areas that may contain submerged vegetation. A wide variety of fish are found in the water column and numerous species of invertebrates and other animals live within vegetation beds.
- Littoral marsh or non-forested wetlands are found on the broad flats that surround the lake. Marsh vegetation provides shelter and food for a variety of organisms that are important food sources for some bird species. In addition, tall wetland plants provide nesting sites and cover for some birds.
- Swamps, or forested wetlands, are found mostly along the southern area of the lake. These areas are located behind the littoral zone and these forests are important roosting and nesting sites for wading birds and many raptors.

Table 16. Bird Species in Highlands County Associated with Lake Istokpoga Habitats.

Species (Common Name)	Nesting Season[1]	Nesting Habitat[1]	Feeding Habitat[1]
American Kestrel	March through June	Cavity nests in swamp trees	Littoral, swamp
Bald Eagle	September through May	High nest on swamp trees	Aquatic[2], littoral, swamp
Barred Owl	December through April	Cavity nests in swamp trees	Littoral, swamp
Black-Necked Stilt	April through June	Littoral vegetation	Aquatic, littoral
Common Moorhen	March through September	Littoral vegetation	Aquatic, littoral
Cooper's Hawk	April through July	Swamp trees	(littoral swamp)[3]
Fulvous Whistling-Duck	March through August	Littoral vegetation	Aquatic, littoral
Great Blue Heron	Extended through the year	Swamp trees	Aquatic, littoral, swamp
Great Egret	Year-round	Swamp trees	Aquatic, littoral, swamp
Green Heron	March through July	Swamp trees or shrubs	Aquatic, littoral, swamp
Limpkin	February through June	Littoral vegetation	Littoral
Mallard		Littoral vegetation	Aquatic, littoral
Mottled Duck	February through September	Littoral vegetation	Aquatic, littoral
Northern Harrier	February through September*		Aquatic, littoral, swamp
Osprey	Year-round	High nest on swamp tree	Aquatic, swamp
Pied-Billed Grebe	Year-round	Littoral vegetation	Aquatic
Purple Gallinule	March through September	Littoral vegetation	Aquatic, littoral
Red-Shouldered Hawk	January through May	Swamp trees	Littoral, swamp
Red-Tailed Hawk	January through June	Nest in mature tree-swamp	Littoral, swamp
Red-Winged Blackbird	March through July	Littoral vegetation	Littoral
Sandhill Crane	December through June	Often nests in wet areas-littoral	Littoral
Short-Tailed Hawk	February through May	Swamp tree	(Littoral, swamp)[2]
Everglades Snail Kite	Year-round	Swamp or littoral vegetation	Littoral
Swallow-Tailed Kite	April	Tall cypress tree-swamp	Littoral, swamp
Tricolor Heron	February through August	Swamp trees or shrubs	Aquatic, littoral
Wood Duck	January through June	Cavity nests	Aquatic, littoral

[1]Source: National Geographic Society 1987, Ehrlich *et al*. 1988, Poole *et al*. 1992, Bird 1999

[2]indicates habitats that have very long hydroperiods, such as aquatic beds and mud flats that may occasionally be exposed during drought conditions

[3]indicates an indirect association

To protect the critical habitats required by many bird species found along Lake Istokpoga, the aquatic, marsh and swamp habitats must be protected from significant changes (i.e., shift to drier community types, with an associated change or loss of function), which is assumed to equate to *significant harm*. It is assumed that MFL criteria, which protect these natural systems, will also protect the bird communities from *significant harm*.

Data that directly relates the effects of low water events to changes in bird populations within Lake Istokpoga is lacking. However, studies from other areas of Florida can provide some insight into potential impacts. Generally, low water levels in wetland-lake systems are associated with improved feeding and successful rearing of chicks since aquatic prey are concentrated into smaller areas (Kushlan 1976, 1986, 1989; Ogden *et al.* 1976). Usually higher water levels or drying of wetlands, which causes mortality of prey, are factors that reduce foraging success. If reduced water levels persist and affect prey habitat or prey populations are reduced, there may be an indirect impact to bird communities.

SUMMARY OF ANALYSIS

There are two distinct periods discernable from the water level time series data for Lake Istokpoga. During the historical, or pre-management, period (1936–1962), Lake Istokpoga fell below 36.5 feet NGVD for seven weeks once every 3.4 years, on average (**Table 13**). From 1962 to present, lake management included control of low water and the lake has only fallen below 36.5 feet NGVD three times. Two of these events were associated with controlled drawdowns to construct a water control structure (1962 – 1963) and to undertake an environmental enhancement project (2001).

The need to protect developed lands along Lake Istokpoga from flooding prohibits reflooding of some remnant swamp areas, particularly those that reside above 39.5 feet NGVD (the upper range of the regulation schedule, see **Figure 11**). It is recognized that wetland communities require a minimum period of flooding and that alteration and development of lake shore areas represents one constraint of managing some natural areas along Lake Istokpoga. It is also recognized that an appropriate depth of flooding is required to maintain the swamp's health; however, that parameter is beyond the MFL scope.

The minimum water level threshold proposed for the Lake Istokpoga MFL criteria is 36.5 feet NGVD. This elevation is derived from the water level identified as the point where surface water is absent in most littoral wetlands along the lake (see **Figures 27, 28 and 29**), and navigation and recreation access to the lake is impaired (**Table 14**). Adverse impacts to fish and bird communities are not expected by periodic, short-duration low water events at or below 36.5 feet NGVD; however, prolonged events may be undesirable. Management of low water events based on these resource functions is in harmony with the considerations set forth in the MFL rule. Impacts to water supply are considered to be minimal, since the current regulation schedule stops water releases from

Lake Istokpoga when water levels fall below the minimum operating level (Zone B), which ranges from 39.0 feet at the end of the wet season to 37.5 feet at the end of the dry season (see **Figures 6** and **11**).